FIG.1

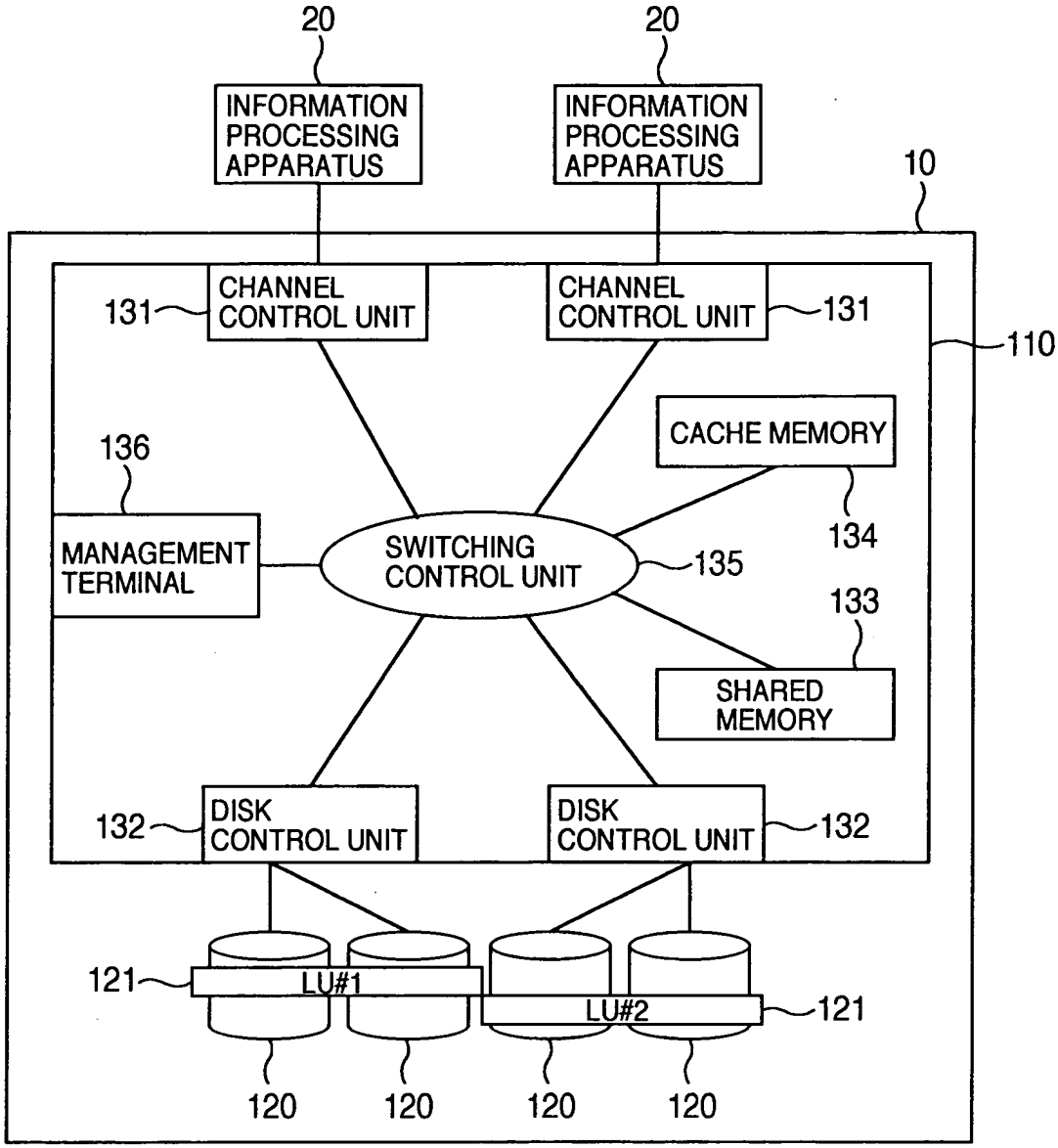

20
20
INFORMATION PROCESSING APPARATUS
INFORMATION PROCESSING APPARATUS
10
131
CHANNEL CONTROL UNIT
CHANNEL CONTROL UNIT
131
110
CACHE MEMORY
136
134
MANAGEMENT TERMINAL
SWITCHING CONTROL UNIT
135
133
SHARED MEMORY
132
DISK CONTROL UNIT
DISK CONTROL UNIT
132
121
LU#1
LU#2
121
120
120
120
120

FIG.2

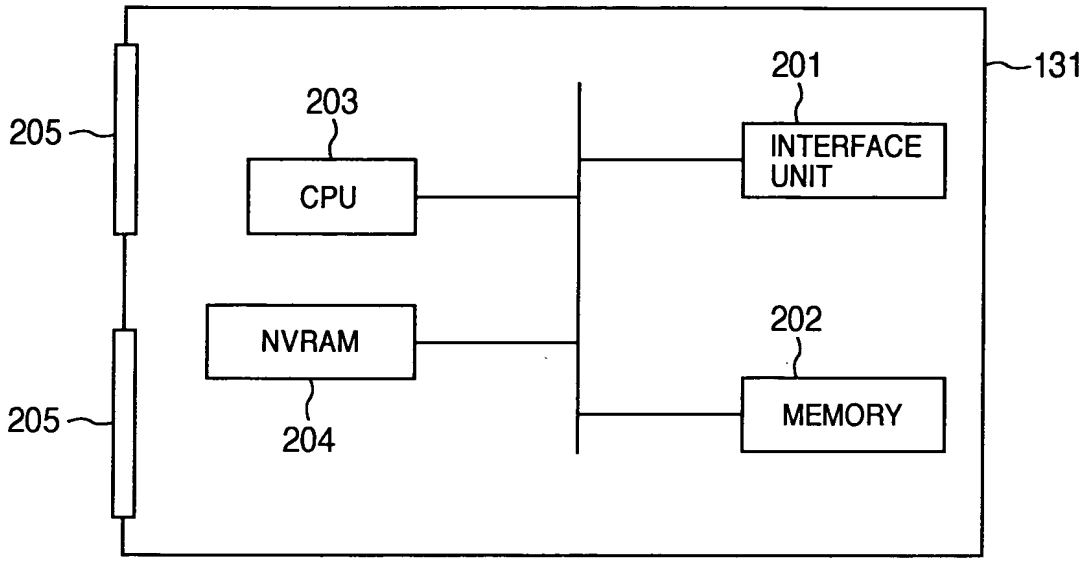

131
201
INTERFACE UNIT
203
CPU
205
NVRAM
204
202
MEMORY
205

FIG.3

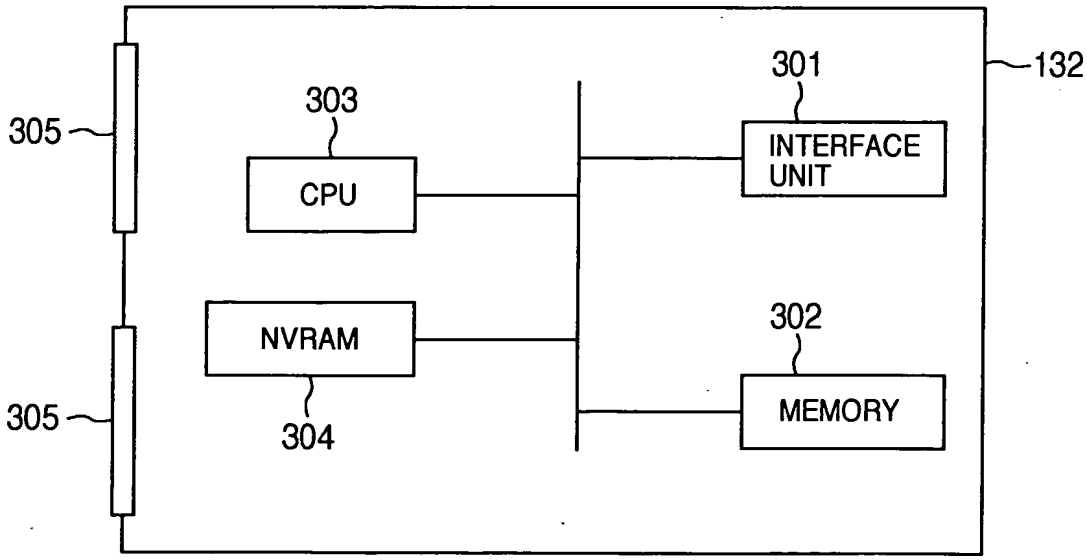

132
301
INTERFACE UNIT
303
CPU
305
NVRAM
304
302
MEMORY
305

FIG.4

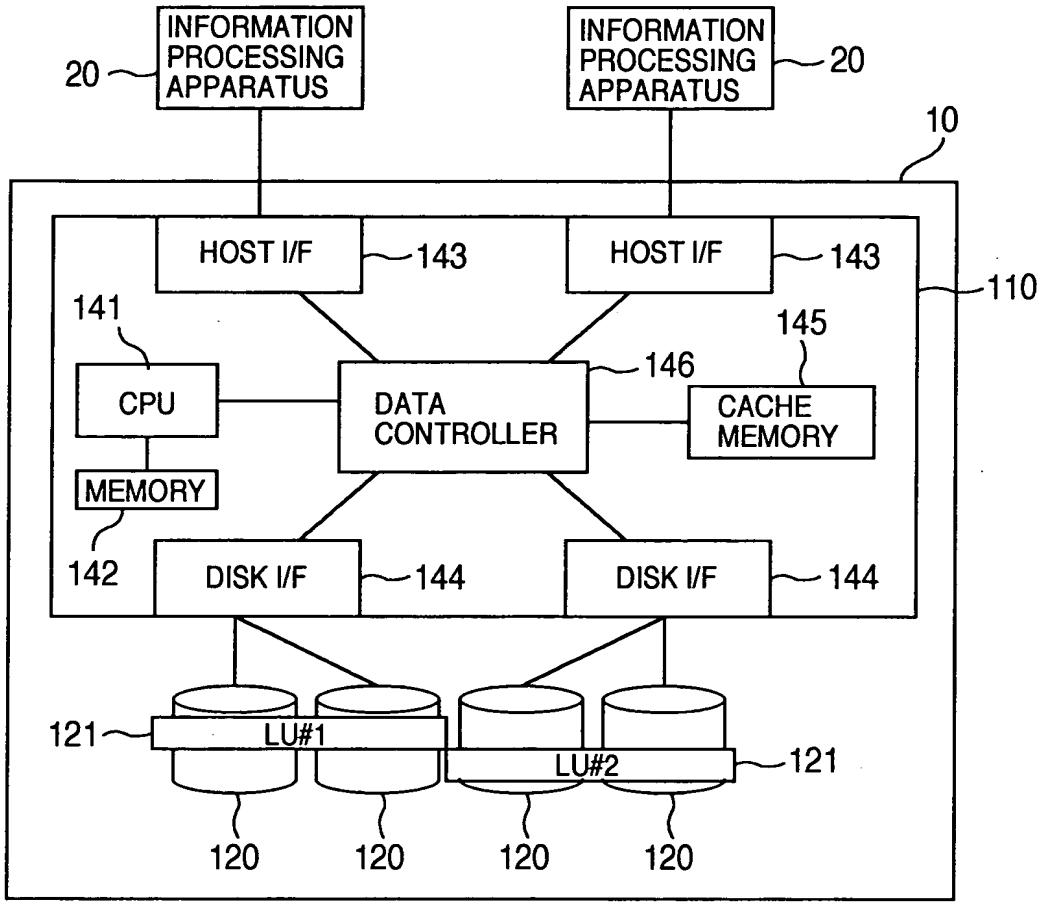

INFORMATION PROCESSING APPARATUS
20
INFORMATION PROCESSING APPARATUS
20
10
HOST I/F
143
HOST I/F
143
110
141
145
CPU
146
DATA CONTROLLER
CACHE MEMORY
MEMORY
142
DISK I/F
144
DISK I/F
144
121
LU#1
LU#2
121
120
120
120
120

FIG.5

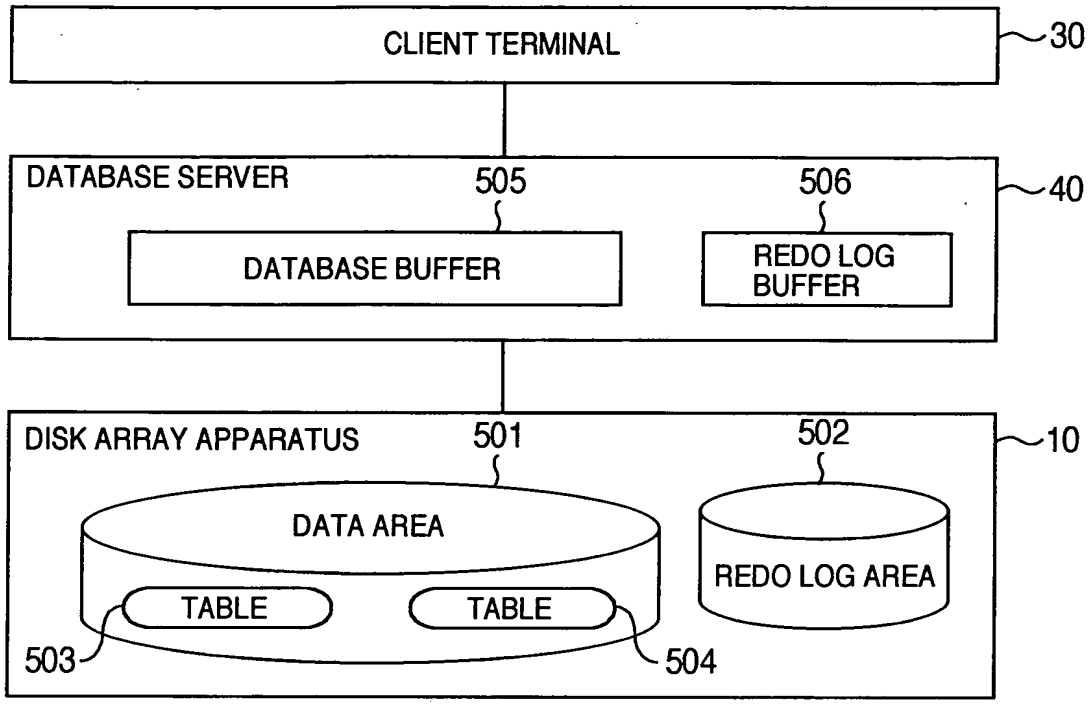

CLIENT TERMINAL
30
DATABASE SERVER
505
506
40
DATABASE BUFFER
REDO LOG BUFFER
DISK ARRAY APPARATUS
501
502
10
DATA AREA
REDO LOG AREA
TABLE
TABLE
503
504

FIG.6

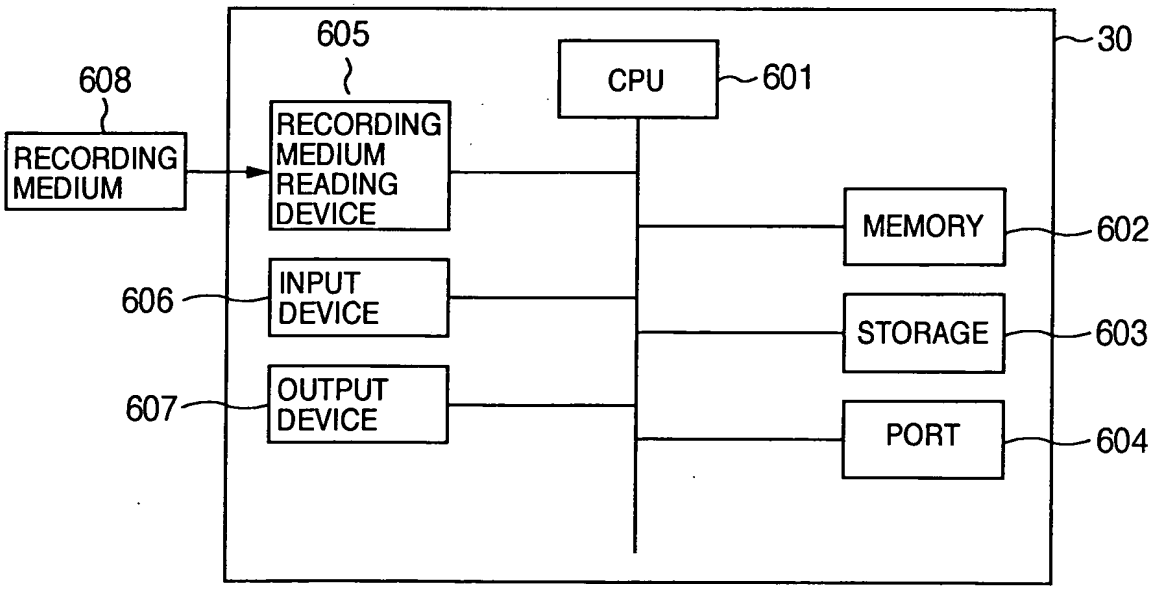

605
608
CPU
601
30
RECORDING MEDIUM
RECORDING MEDIUM READING DEVICE
MEMORY
602
606
INPUT DEVICE
STORAGE
603
607
OUTPUT DEVICE
PORT
604

FIG.7

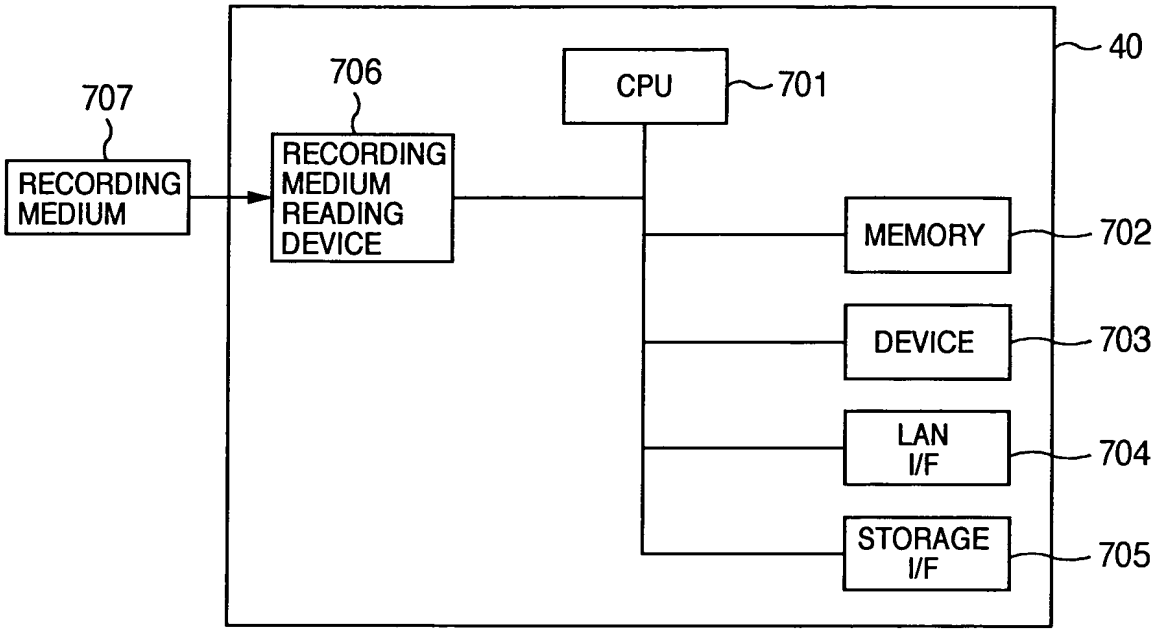

40
706
CPU
701
707
RECORDING MEDIUM
RECORDING MEDIUM READING DEVICE
MEMORY
702
DEVICE
703
LAN I/F
704
STORAGE I/F
705

FIG.8

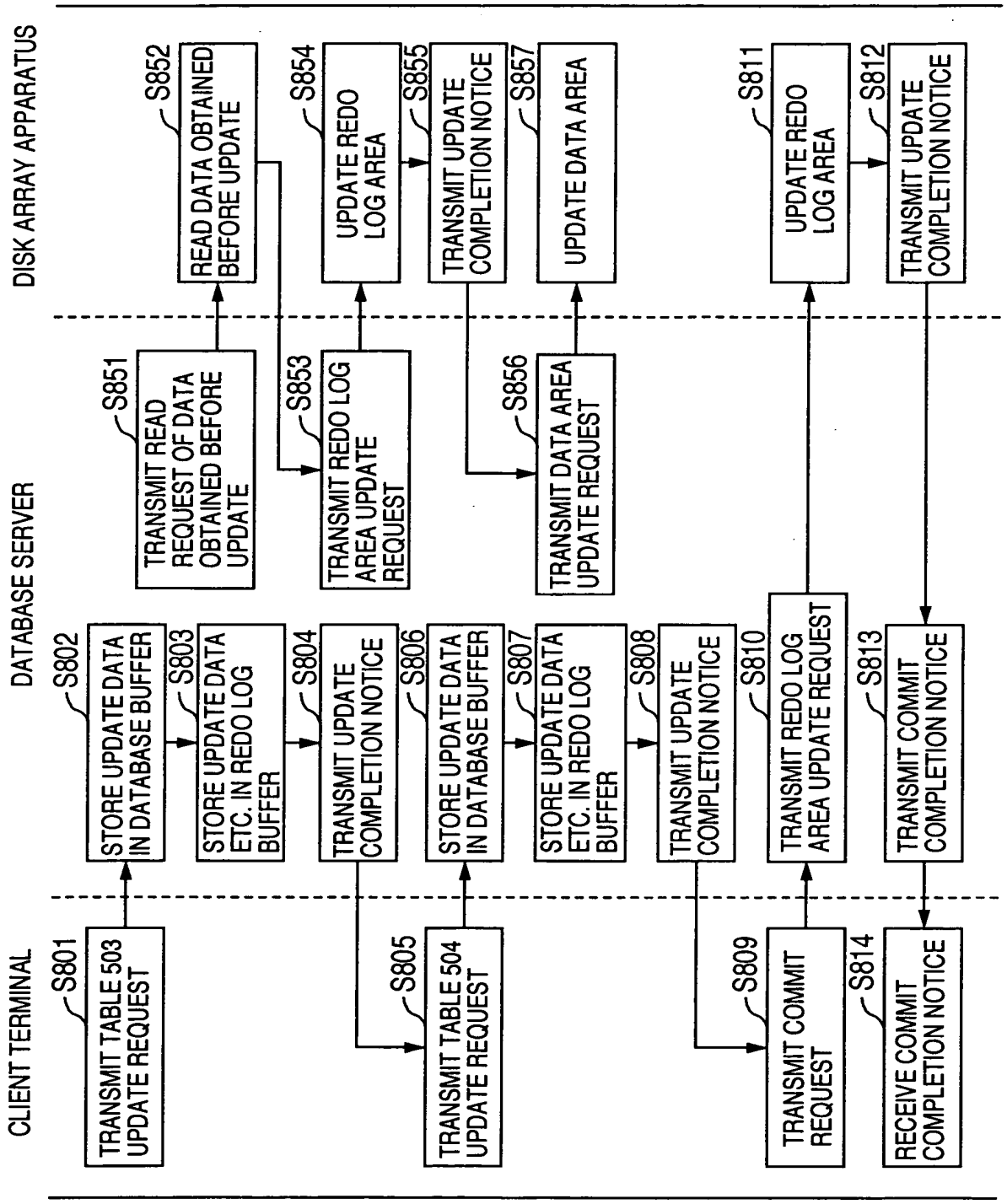

CLIENT TERMINAL
DATABASE SERVER
DISK ARRAY APPARATUS
S801
TRANSMIT TABLE 503 UPDATE REQUEST
S802
STORE UPDATE DATA IN DATABASE BUFFER
S803
STORE UPDATE DATA ETC. IN REDO LOG BUFFER
S804
TRANSMIT UPDATE COMPLETION NOTICE
S805
TRANSMIT TABLE 504 UPDATE REQUEST
S806
STORE UPDATE DATA IN DATABASE BUFFER
S807
STORE UPDATE DATA ETC. IN REDO LOG BUFFER
S808
TRANSMIT UPDATE COMPLETION NOTICE
S809
TRANSMIT COMMIT REQUEST
S810
TRANSMIT REDO LOG AREA UPDATE REQUEST
S811
UPDATE REDO LOG AREA
S812
TRANSMIT UPDATE COMPLETION NOTICE
S813
TRANSMIT COMMIT COMPLETION NOTICE
S814
RECEIVE COMMIT COMPLETION NOTICE
S851
TRANSMIT READ REQUEST OF DATA OBTAINED BEFORE UPDATE
S852
READ DATA OBTAINED BEFORE UPDATE
S853
TRANSMIT REDO LOG AREA UPDATE REQUEST
S854
UPDATE REDO LOG AREA
S855
TRANSMIT UPDATE COMPLETION NOTICE
S856
TRANSMIT DATA AREA UPDATE REQUEST
S857
UPDATE DATA AREA

FIG.9

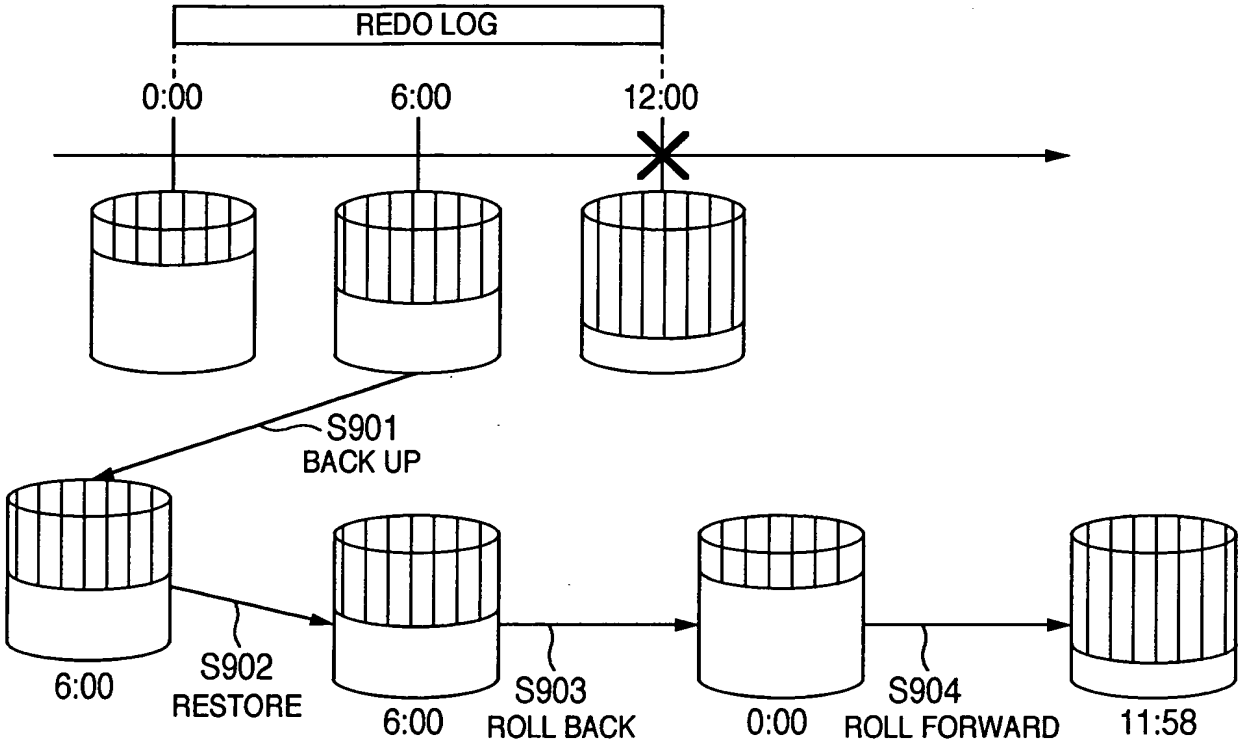

REDO LOG
0:00
6:00
12:00
S901
BACK UP
6:00
S902
RESTORE
6:00
S903
ROLL BACK
0:00
S904
ROLL FORWARD
11:58

FIG.10

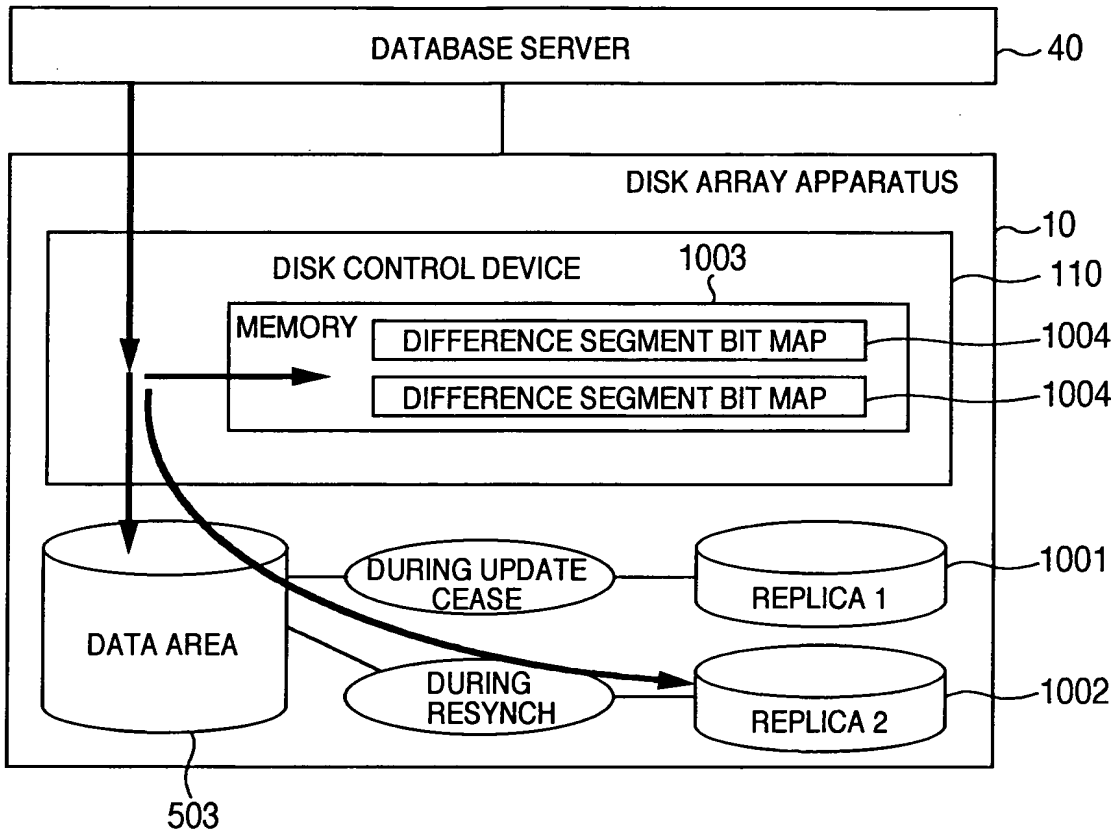

DATABASE SERVER
40
DISK ARRAY APPARATUS
10
DISK CONTROL DEVICE
1003
110
MEMORY
DIFFERENCE SEGMENT BIT MAP
1004
DIFFERENCE SEGMENT BIT MAP
1004
DURING UPDATE CEASE
REPLICA 1
1001
DATA AREA
DURING RESYNCH
REPLICA 2
1002
503

FIG.11

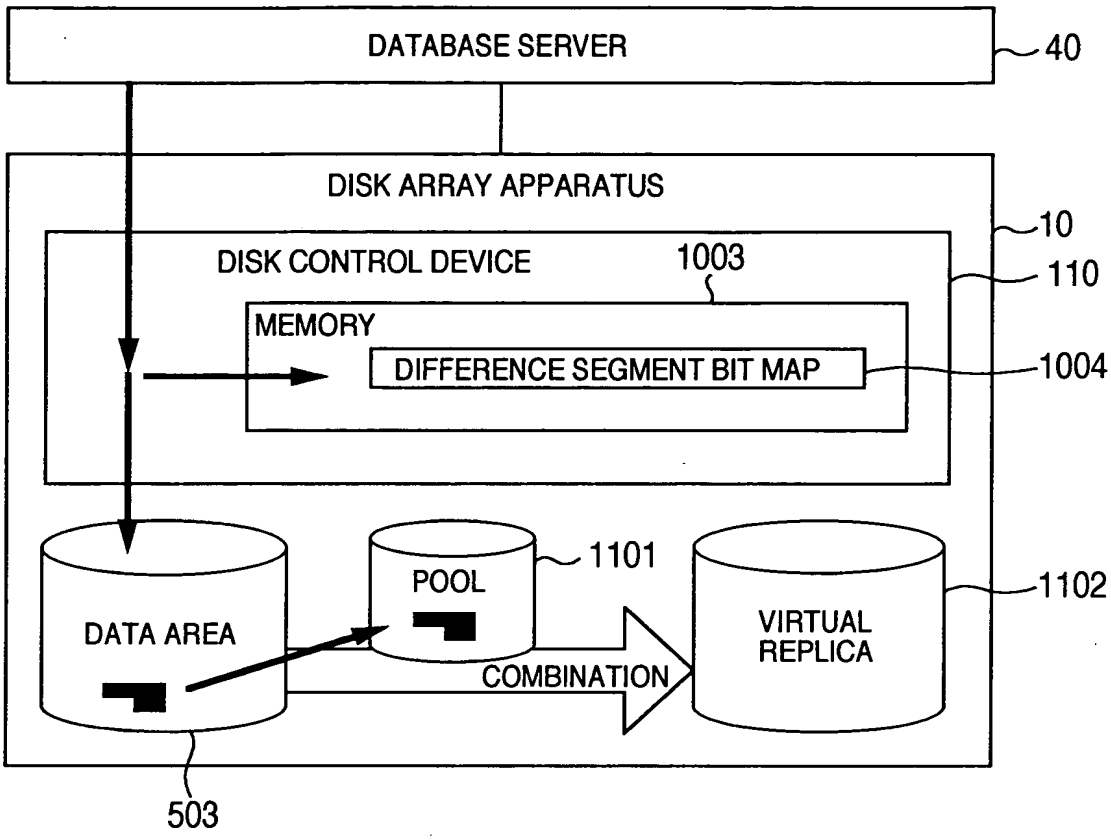

DATABASE SERVER
40
DISK ARRAY APPARATUS
10
DISK CONTROL DEVICE
1003
110
MEMORY
DIFFERENCE SEGMENT BIT MAP
1004
DATA AREA
POOL
1101
1102
VIRTUAL REPLICA
COMBINATION
503

FIG.12

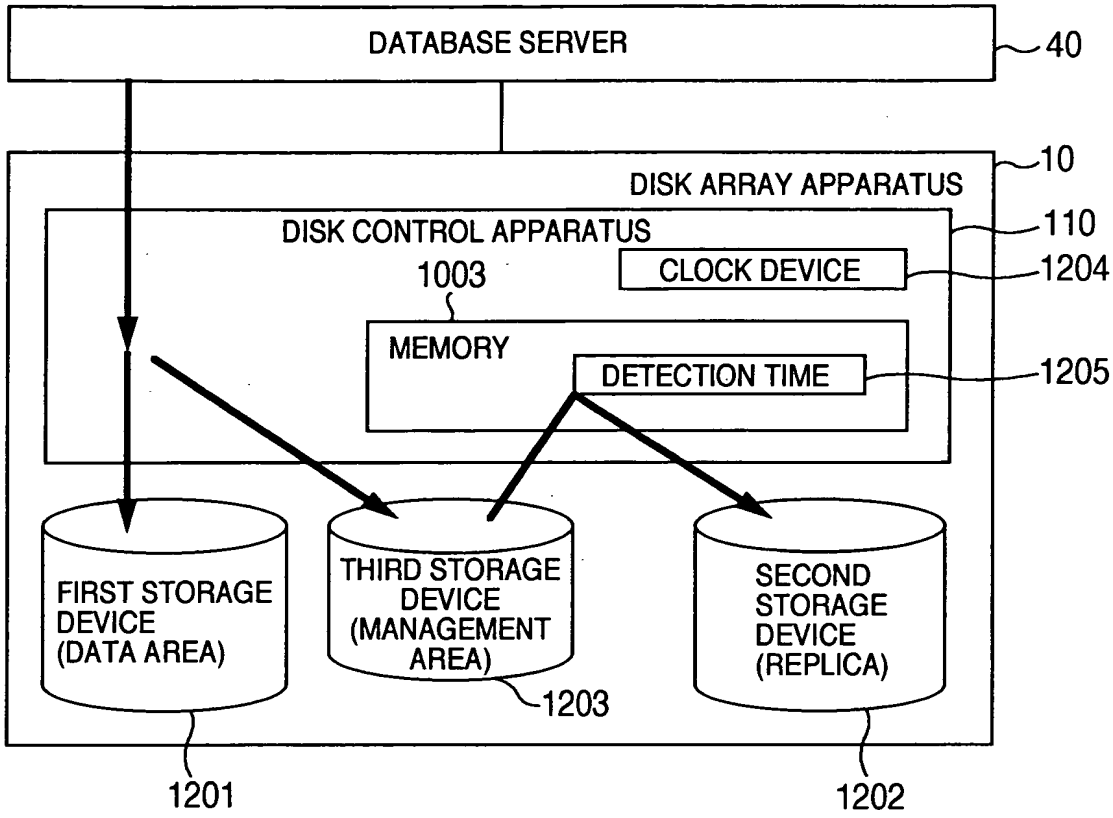

DATABASE SERVER
40
10
DISK ARRAY APPARATUS
110
DISK CONTROL APPARATUS
1003
CLOCK DEVICE
1204
MEMORY
DETECTION TIME
1205
FIRST STORAGE DEVICE (DATA AREA)
THIRD STORAGE DEVICE (MANAGEMENT AREA)
1203
SECOND STORAGE DEVICE (REPLICA)
1201
1202

FIG.13

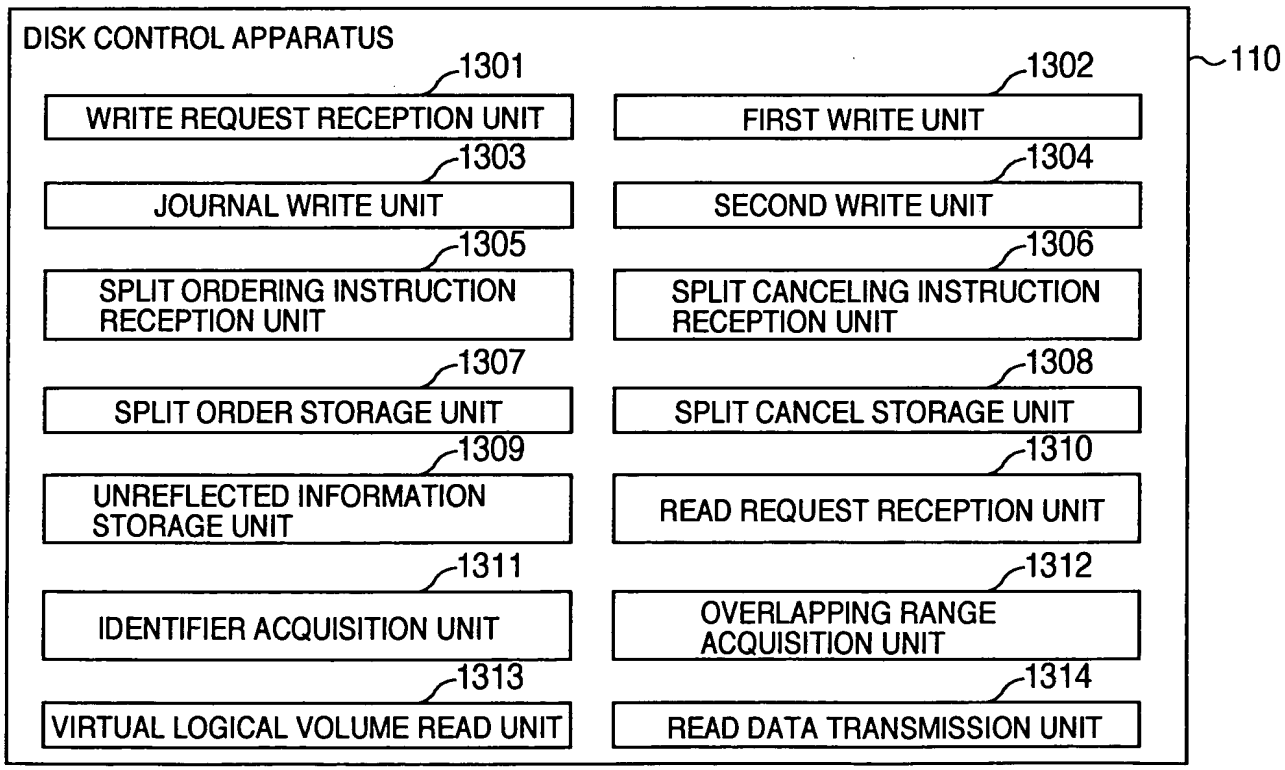

DISK CONTROL APPARATUS
110
1301
WRITE REQUEST RECEPTION UNIT
1302
FIRST WRITE UNIT
1303
JOURNAL WRITE UNIT
1304
SECOND WRITE UNIT
1305
SPLIT ORDERING INSTRUCTION RECEPTION UNIT
1306
SPLIT CANCELING INSTRUCTION RECEPTION UNIT
1307
SPLIT ORDER STORAGE UNIT
1308
SPLIT CANCEL STORAGE UNIT
1309
UNREFLECTED INFORMATION STORAGE UNIT
1310
READ REQUEST RECEPTION UNIT
1311
IDENTIFIER ACQUISITION UNIT
1312
OVERLAPPING RANGE ACQUISITION UNIT
1313
VIRTUAL LOGICAL VOLUME READ UNIT
1314
READ DATA TRANSMISSION UNIT

FIG.14

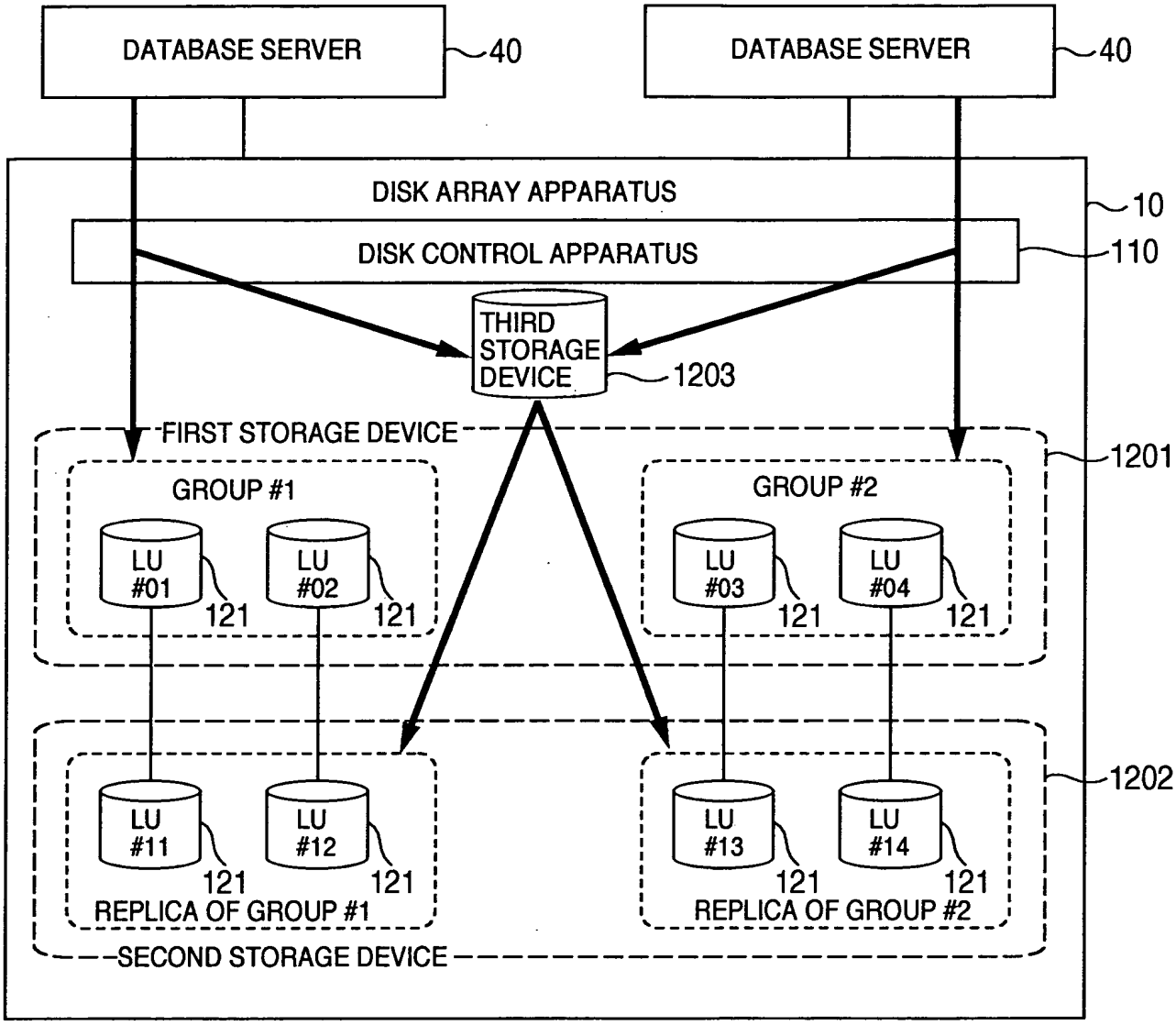

DATABASE SERVER
40
DATABASE SERVER
40
DISK ARRAY APPARATUS
10
DISK CONTROL APPARATUS
110
THIRD STORAGE DEVICE
1203
FIRST STORAGE DEVICE
1201
GROUP #1
GROUP #2
LU #01
LU #02
LU #03
LU #04
121
121
121
121
1202
LU #11
LU #12
LU #13
LU #14
121
121
121
121
REPLICA OF GROUP #1
REPLICA OF GROUP #2
SECOND STORAGE DEVICE

FIG.15

PRIMARY LOGICAL VOLUME	SECONDARY LOGICAL VOLUME
LU#01	LU#11
LU#02	LU#12
LU#03	LU#13
LU#04	LU#14
⋮	⋮

1501

FIG.16

LOGICAL VOLUME	GROUP ID
LU#01	1
LU#02	1
LU#03	2
LU#04	2
⋮	⋮

1601

FIG.17

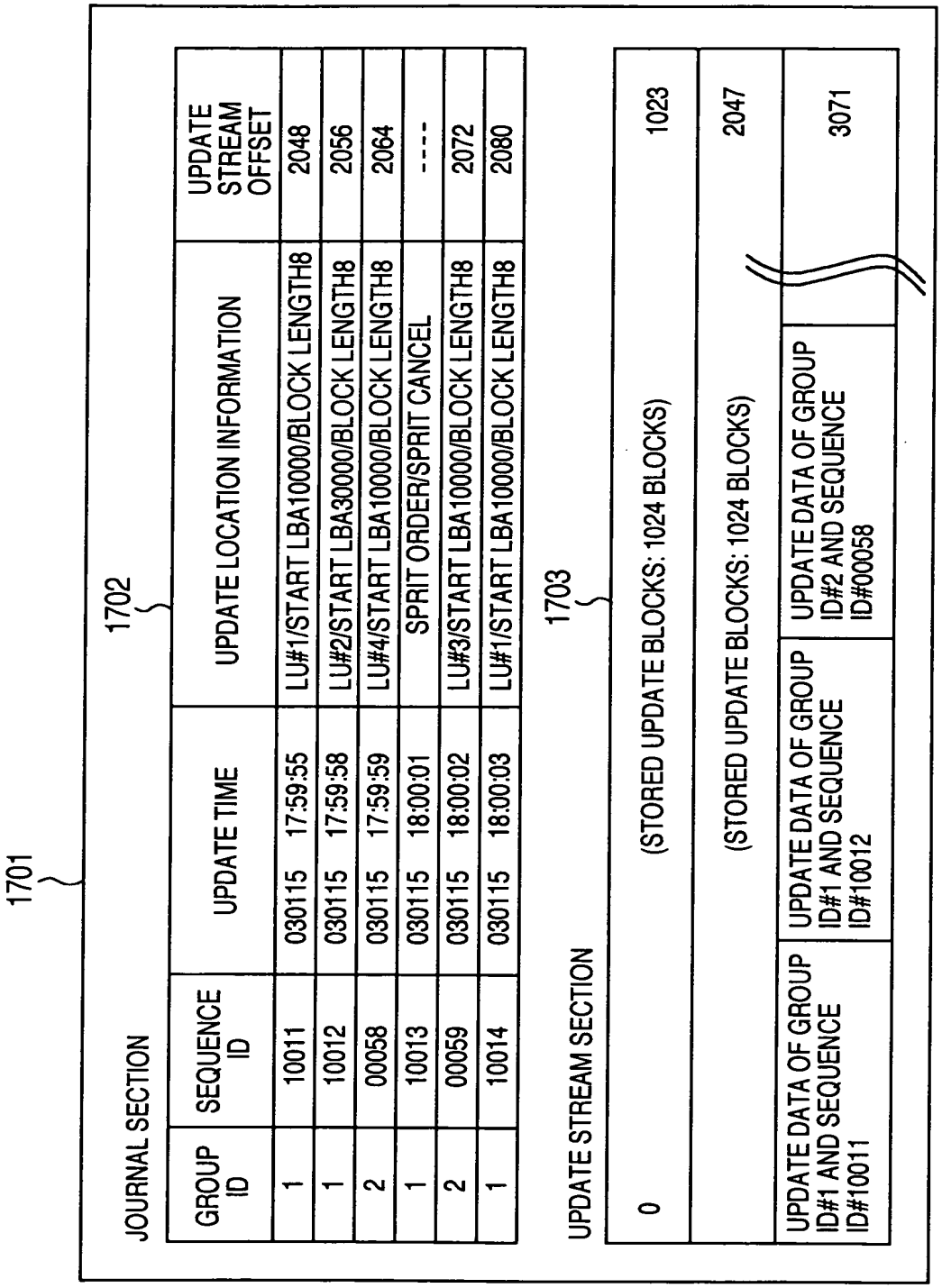

1701
JOURNAL SECTION
1702
GROUP ID
SEQUENCE ID
UPDATE TIME
UPDATE LOCATION INFORMATION
UPDATE STREAM OFFSET
1 10011 030115 17:59:55 LU#1/START LBA10000/BLOCK LENGTH8 2048
1 10012 030115 17:59:58 LU#2/START LBA30000/BLOCK LENGTH8 2056
2 00058 030115 17:59:59 LU#4/START LBA10000/BLOCK LENGTH8 2064
1 10013 030115 18:00:01 SPRIT ORDER/SPRIT CANCEL ----
2 00059 030115 18:00:02 LU#3/START LBA10000/BLOCK LENGTH8 2072
1 10014 030115 18:00:03 LU#1/START LBA10000/BLOCK LENGTH8 2080
UPDATE STREAM SECTION
1703
0
(STORED UPDATE BLOCKS: 1024 BLOCKS)
1023
(STORED UPDATE BLOCKS: 1024 BLOCKS)
2047
UPDATE DATA OF GROUP ID#1 AND SEQUENCE ID#10011
UPDATE DATA OF GROUP ID#1 AND SEQUENCE ID#10012
UPDATE DATA OF GROUP ID#2 AND SEQUENCE ID#00058
3071

FIG.18

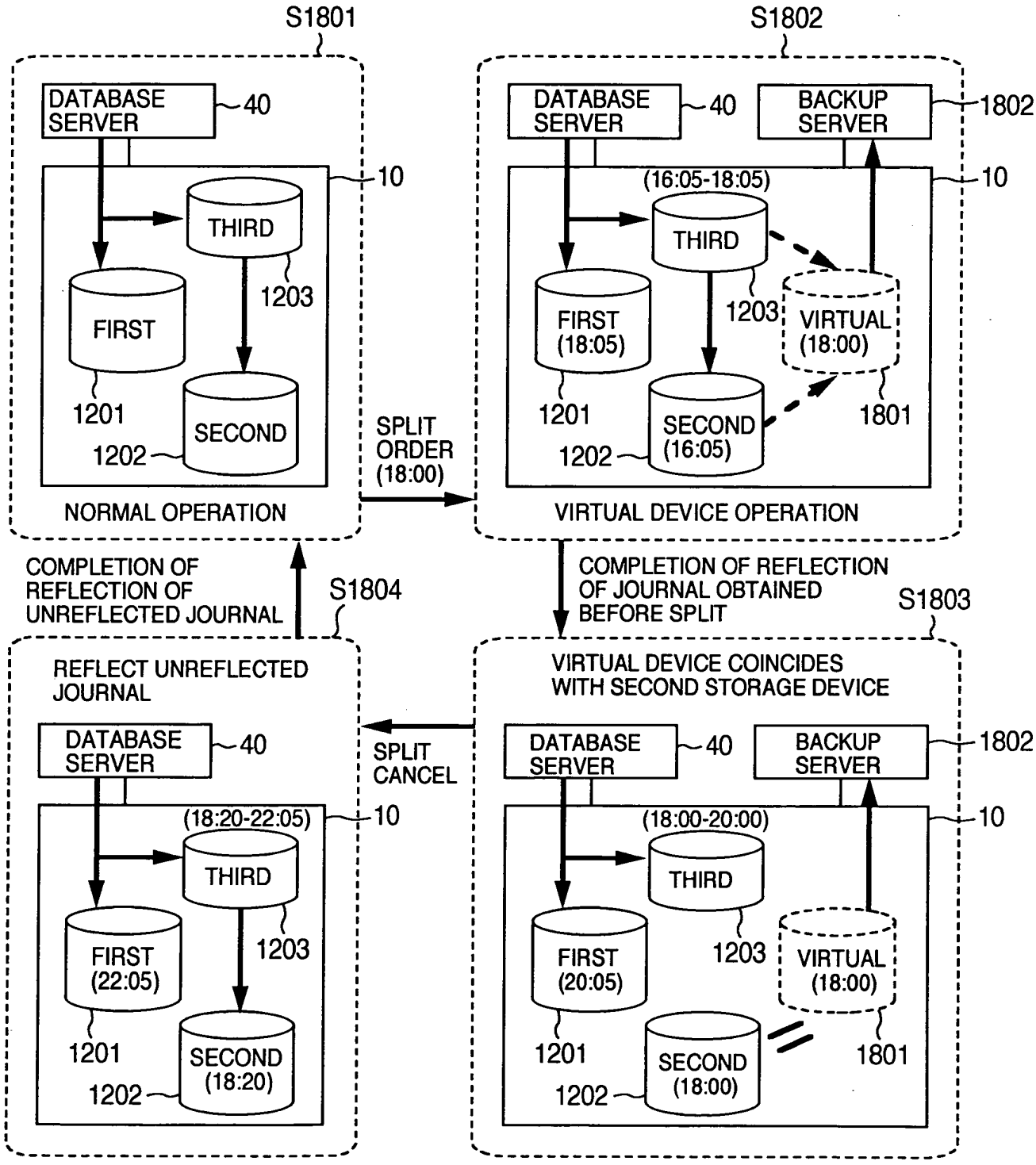

S1801
S1802
DATABASE SERVER
40
BACKUP SERVER
1802
10
THIRD
1203
FIRST
1201
SECOND
1202
(16:05-18:05)
FIRST (18:05)
VIRTUAL (18:00)
1801
SECOND (16:05)
SPLIT ORDER (18:00)
NORMAL OPERATION
VIRTUAL DEVICE OPERATION
COMPLETION OF REFLECTION OF UNREFLECTED JOURNAL
S1804
COMPLETION OF REFLECTION OF JOURNAL OBTAINED BEFORE SPLIT
S1803
REFLECT UNREFLECTED JOURNAL
VIRTUAL DEVICE COINCIDES WITH SECOND STORAGE DEVICE
SPLIT CANCEL
(18:20-22:05)
FIRST (22:05)
SECOND (18:20)
(18:00-20:00)
FIRST (20:05)
SECOND (18:00)

FIG.19

LOGICAL VOLUME	VIRTUAL LOGICAL VOLUME
LU#11	LU#21
LU#12	LU#22
LU#13	LU#23
LU#14	LU#24
⋮	⋮

1901

FIG.20

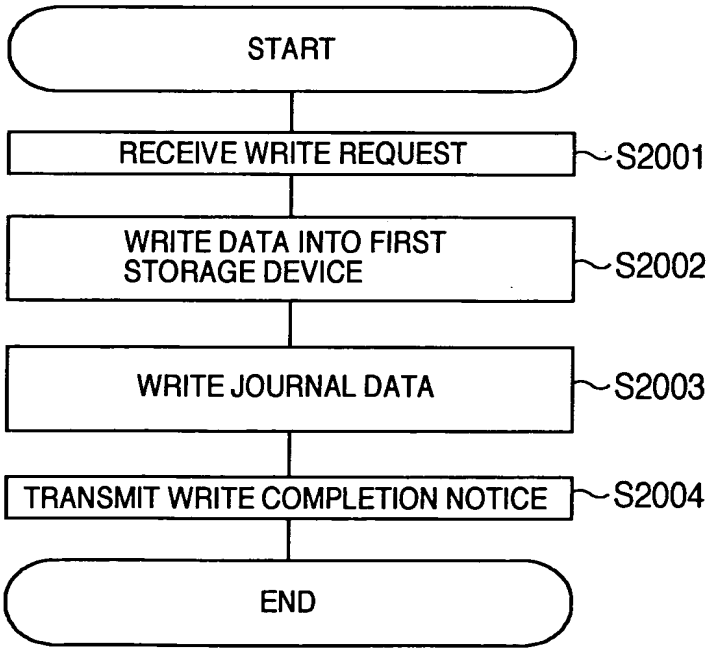


FIG.21

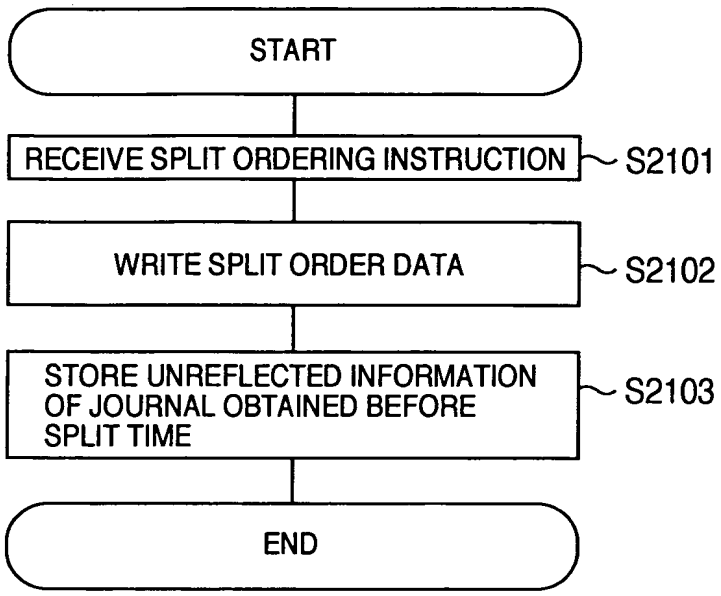

START
RECEIVE SPLIT ORDERING INSTRUCTION
S2101
WRITE SPLIT ORDER DATA
S2102
STORE UNREFLECTED INFORMATION OF JOURNAL OBTAINED BEFORE SPLIT TIME
S2103
END

FIG.22

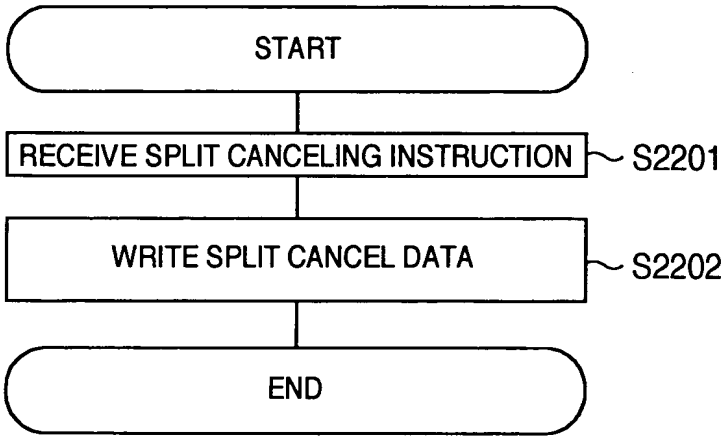

START
RECEIVE SPLIT CANCELING INSTRUCTION
S2201
WRITE SPLIT CANCEL DATA
S2202
END

FIG.23

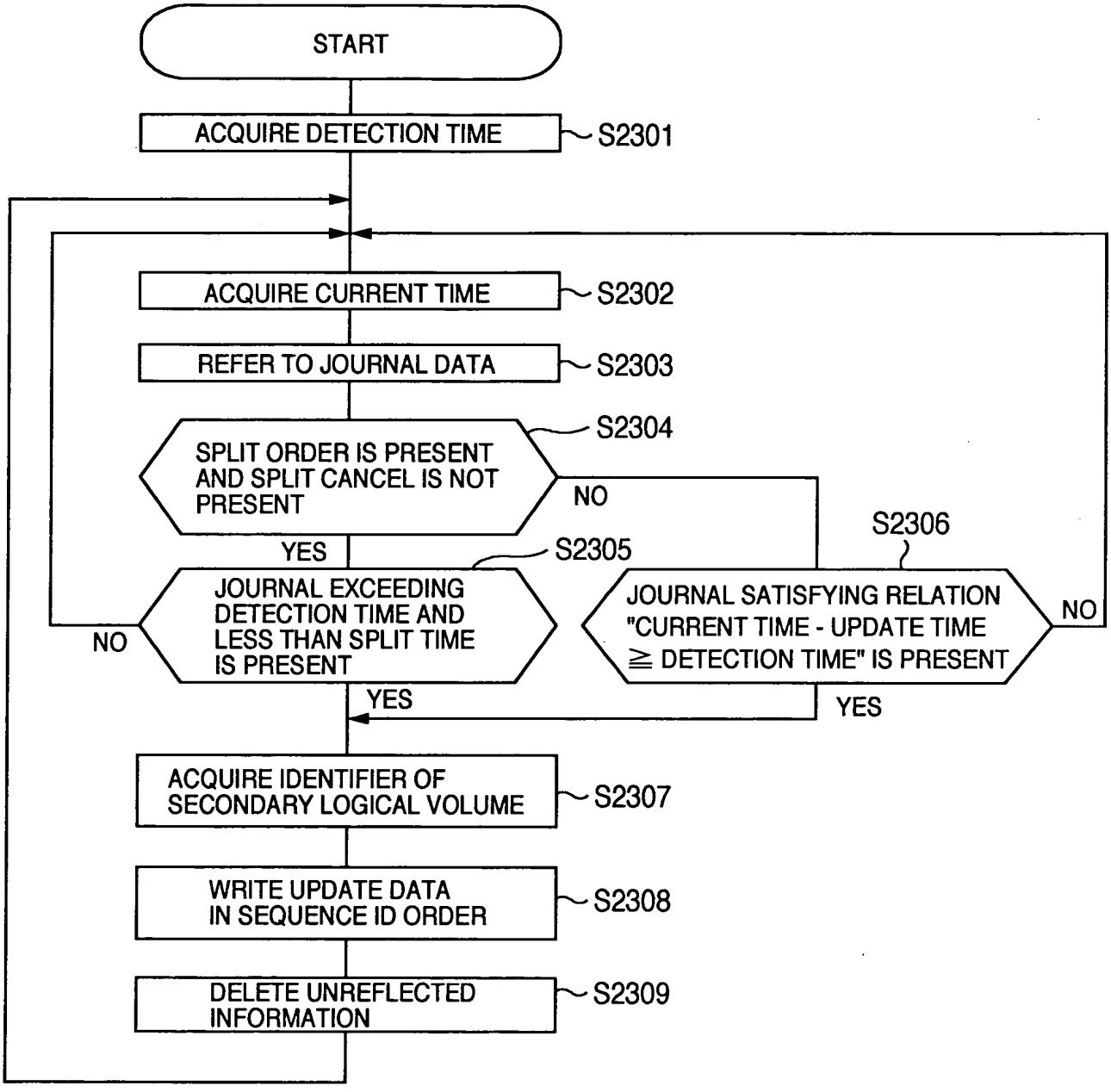
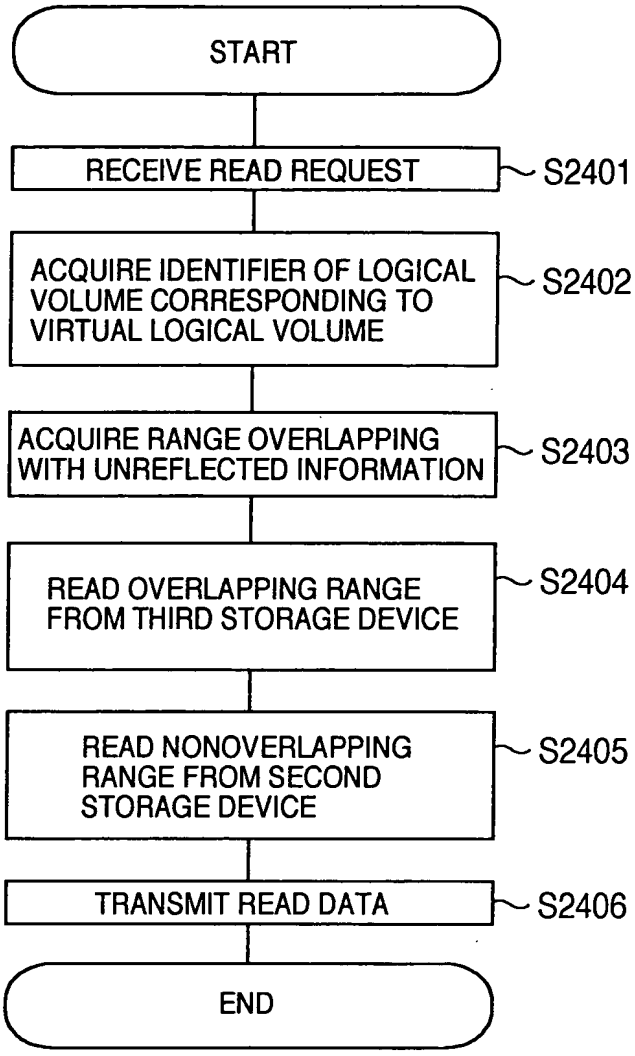

START
ACQUIRE DETECTION TIME
S2301
ACQUIRE CURRENT TIME
S2302
REFER TO JOURNAL DATA
S2303
S2304
SPLIT ORDER IS PRESENT AND SPLIT CANCEL IS NOT PRESENT
NO
YES
S2305
JOURNAL EXCEEDING DETECTION TIME AND LESS THAN SPLIT TIME IS PRESENT
NO
S2306
JOURNAL SATISFYING RELATION "CURRENT TIME - UPDATE TIME ≧ DETECTION TIME" IS PRESENT
NO
YES
YES
ACQUIRE IDENTIFIER OF SECONDARY LOGICAL VOLUME
S2307
WRITE UPDATE DATA IN SEQUENCE ID ORDER
S2308
DELETE UNREFLECTED INFORMATION
S2309

FIG.24


START
RECEIVE READ REQUEST
S2401
ACQUIRE IDENTIFIER OF LOGICAL VOLUME CORRESPONDING TO VIRTUAL LOGICAL VOLUME
S2402
ACQUIRE RANGE OVERLAPPING WITH UNREFLECTED INFORMATION
S2403
READ OVERLAPPING RANGE FROM THIRD STORAGE DEVICE
S2404
READ NONOVERLAPPING RANGE FROM SECOND STORAGE DEVICE
S2405
TRANSMIT READ DATA
S2406
END